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**THE DEVELOPMENT OF CURRICULUM FOR A HIGH SCHOOL
COURSE INTEGRATING DRAFTING AND MATHEMATICS**

**A Project
Presented to the
Faculty of
California State University,
San Bernardino**

**In Partial Fulfillment
of the Requirements for the Degree
Master of Arts
in
Education: Vocational Education**

**by
Diana Lynn McVicker**

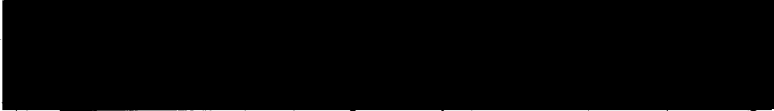
December 1997

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Approved by:


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12/10/97
Date


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ABSTRACT

This study evaluated numerous articles, three local vocational education programs, and three integrated program studies. All of the information reviewed discussed the value, method, and results associated with the integration of industrial arts and academics. The impetus for change is the corporate world and federal and state legislation. These factions see value in the concept of applied skills. Validation of vocational education's role in the development of projected student outcomes through applied skills is an important issue receiving concurrence from the Carl D. Perkins Vocational Education Act, School-to-Work Opportunities Act, and California's School-to-Career Plan. Recognition of the inherent core subject matter taught within the framework of the traditional shop class is important. Math, science, and history is subject matter embedded in the traditional shop class. Vocational education plays a very important part in making sense out of the mundane and answering the question, "Why do I need to know this?" Studies show that the design of today's work force will look different in the year 2000, and the need for unskilled laborers will decrease and the percentage of needed skilled workers will increase. Thus, schools need to rethink their attitude toward vocational education and rather than eliminate programs they need to redesign them to meet the changing work force. The goal of this project was the development of an integrated mechanical drafting and mathematics course incorporating the elements of Math B. The results of this project showed evidence of the importance of integrating mathematics with vocational education classes in the form of academies, career paths and certificate programs, and alternative credit options.

ACKNOWLEDGEMENTS

The development of this project has been a dream for a number of years. The dream is a direct reflection of personal vocational education, work experience, and current teaching experience. This project, like most, did not come to fruition through any single endeavor. It becomes extremely important then to acknowledge family, friends, colleagues, and professors that have tolerated, influenced, and guided me in the development of this project. The following need to be recognized for their contribution:

Mrs. Diana Mock, teacher at Nogales High School and Math Mentor for Rowland Unified School District.

Mrs. Jan Holdridge, teacher and Mathematics Department Chair at Nogales High School, Rowland Unified School District.

Ms. Carole Solis, SDC teacher at Nogales High School, Rowland Unified School District.

Mrs. Sandi Nelson, Science teacher at Nogales High School, Rowland Unified School District.

Mr Walter P. Chrysler (1956) who wrote,

My opinion of myself had expanded tenfold when I became an apprentice. Everybody in Ellis knew that any apprentice had been required to pass an examination--a stiff one. Some boys failed to make the grade, but I had done so readily, because mathematics was one of my good subjects. I had used mathematics when I worked in the grocery store, to help George Henderson figure out his cost. I had used it, too, when we were building a house, but I had never used it to better effect on my life than when I worked out some of the examination problems that had to do with locomotive wheels and driving rods.

Adeline and Harvey Roloff for their faith in higher achievement

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CHAPTER ONE

Background

Introduction

Mechanical drafting does much more than introduce students to a vocational skill. Mechanical drafting reviews and incorporates, as applied skills, math concepts on a regular basis. Mechanical drafting fits under the umbrella of industrial arts and is not regularly viewed as a viable department from which students can glean alternative academic credit toward graduation. Through legislation and the assistance of vocational education advocates, industrial arts departments and programs are being revamped thus providing a path to success. The focus of this project is on a curriculum design based on the elements of California's Math B program and how one element, Transportation, can be applied to mechanical drafting providing students an opportunity for alternative math credit.

Context of the Problem

Integration and career paths are but a few of the new buzz words associated with current educational transformations. Transformations initiated by the development of the California High School Investment document, The Scans Report, Second to None, and California's School-to-Career initiative. As an innate component of all these reports, integration and career paths emerge as a common thread for an educational direction focused on life long learning and social awareness and commitment. Hopefully, as programs are sculpted, designers will look to industrial technology programs as a viable vehicle for cross-curricular integration. Integration that will bring relevance and direct application to learning.

Research indicates the need for integrated programs that cross over imaginary barriers, barriers that have kept industrial technology separate from the academic courses. The viability and importance of this linkage is immeasurable. The need for programming that transcends the traditional has become interwoven in state documents as previously mentioned. Integration is an important component for the systemic changes integral to

what comprises the School-to-Work Opportunities Act (STWOA). Advocates of industrial technology, and those educators who have transitioned from the manual training to technology education, welcome the renewed interest in the value of these programs. Interpreters of technology realize its many facets and the innate versatility it provides when developing programming. Technology educators provide relevant and appropriate exposure to the world of work through applied problems (Gow, 1995).

Purpose of the Project

The purpose of this project was to develop a technical mathematics curriculum based on the state framework for a first semester mechanical drafting program. This proposed program was designed for high school students in grades ten through twelve. The curriculum was designed to serve the technical and mathematical needs of high school students in the Rowland Unified School District and more specifically, those students at Nogales High School. The impetus for this program began as a simple desire to meet the needs of the high school population by providing an alternative credit option and linking two courses. The expansion of the integration of curricula is an important issue. The content of the curriculum integrates first semester Mechanical Drafting themes and the Transportation segment of Math B.

Significance of the Project

The current mathematics and mechanical drawing curriculum does not provide students alternative or integrated course work that has relevance for those students not immediately continuing their education beyond grade twelve. This curriculum provides students with the skills necessary to opt for mathematics or vocational education graduation credits. Further, the content being taught in the Rowland Unified School District will be the most assessable to all students.

Technical mathematics (integrated math and drafting) will not be designed as an entity in and of itself. This course is being designed to align with existing advanced math and drafting courses thus providing all interested students a continuum. The sequencing for entry into this course will be by teacher recommendation. This course will address the Focus on Learning (FOLs) topics of, Powerful Teaching/Learning and Support-Personal

and Academic Growth. It will also address the Essential Student Learning Requirements (ESLRs) topics of Effective Communicators, Problem Solvers, Critical Thinkers.

Limitations and Delimitations

A number of limitations and delimitations surfaced during the development of this project.

Limitations. The following limitations apply to this project:

1. This project is limited by the availability of a high school drafting lab.
2. This project was developed based upon site available computer software.

Delimitation. The following delimitation applies to this project:

1. The computer portion of the project was specifically developed for IBM or compatible personal computers capable of running CAD/CAM software.

Definition of Terms

The following terms are defined as they apply to this project.

CAD/CAM--Computer Aided Design and Computer Aided Manufacturing

Hardware--The workstation monitor, computer, and peripherals

Software--Computer operating programs and third party programs

Cross-curricular--course work credit agreement between industrial arts and academic instructors for a student generated assignment.

Technology-- Subject matter defined by Industrial Arts, Manual Arts, Trades, Technology Education, and Vocational Education course content.

Integration--A course blending academics with Industrial Arts.

Technology Education--Subject matter defined by Industrial Arts, Manual Arts, Trades, Technology Education, and Vocational Education course content.

Industrial Arts--Subject matter defined by Industrial Arts, Manual Arts, Trades, Technology Education, and Vocational Education course content.

Vocational Education--Subject matter defined by Industrial Arts, Manual Arts, Trades, Technology Education, and Vocational Education course content.

Organization of the Project

This project is divided into five chapters. Chapter one provides an introduction to the context of the problem, purpose of the project, significance of the project, limitations and delimitation, and definition of terms. Chapter Two consists of a review of the literature. Chapter Three outlines the population to be served and the project design. Chapter Four reviews the budget required for implementing the project. Chapter Five presents the conclusions and recommendations gleaned from the project. The project and references follow Chapter Five.

CHAPTER TWO

Review of the Literature

Introduction

Research indicates the need for integrated programs that cross over imaginary barriers, barriers that have kept industrial technology separate from the academic courses. The viability and importance of this linkage is immeasurable. The need for programming that transcends the traditional has become inter-woven within a state document (The California School-to-Career Plan, 1995), and is but one important component for the systemic changes integral to what comprises the School-to-Work Opportunities Act (STWOA). Advocates of industrial technology, and those educators who have transitioned from the manual training to technology education, welcome the renewed interest in the value of these documents. Instructors of technology realize its many facets and the innate versatility it provides when developing programming. Technology educators provide relevant and appropriate exposure to the world of work through applied problems (Gow, 1995).

Three questions prevail in the development of this project. Specifically, (1) understanding the driving force behind the implementation of cross-curricular integration, (2) discovery of the prevalence of programs integrating vocational and academic classes, and (3) the importance of integrating vocational and academic class curriculum for the success and life long learning of all students.

Literature Subsection One

What is the impetus for implementation of programs that integrate vocational education and academics?

Advocacy of the trades dates back to the time of Dewey who was fearful that without apprenticeships the skills needed to maintain the integrity of major industries would soon die. Dewey's concern is not unlike those of today's educators and intermediaries through the decades. According to the United States Department of Education, (Digest of Education Statistics , 1994), early Federal Education Legislation

provided land grants to establish and maintain agriculture and mechanical colleges with the Morrill Act, 1862. The Smith-Hughes Act, 1917, provided support for vocational education via grants to states. In 1963, the Vocational Education Act increased federal support of vocational education schools, vocational work study programs; and research, training, and demonstrations in vocational education. This Act was replaced by the Carl D. Perkins Vocational Education Act in 1984. The 1977 Youth Employment and Demonstration Projects Act established a youth employment training program that promoted education-to-work transition and literacy training. Goals 2000: Educate America Act and School-To-Work Opportunities Act emerged in 1993.

Realization of the important contribution industrial technology makes in the overall education of the high school student has not consistently been strong, but it is again gaining momentum (Grubb, 1993). The integration of industrial technology and academics is one of the five elements outlined in California's Vision (The California School-to-Career Plan, 1995) and is a component of the Carl D. Perkins Vocational and Applied Technology Education Act Amendments. Although integration is not a new concept, it is getting more attention as the business community, technology, and academic instructors begin to work together toward a common goal.

The Carl D. Perkins Vocational and Applied Technology Education Act Amendments of 1990 address the importance of integrating academic and vocational education in order to make the United States a more competitive nation. In recent years, educators have looked at this document as a way in which to improve the quality of education being provided students. Section 2 of the act states,

It is the purpose of this Act to make the United States more competitive in the world economy by developing more fully the academic and occupational skills of all segments of the population. This purpose will principally be achieved through concentrating resources on improving educational programs leading to academic and occupational skill competencies needed to work in a technologically advanced society (Perkins Act, 1990). California's proposal, School-to-Career, responded to the federal School-to-Work

Opportunities Act (STWOA) set forth during the Clinton administration. STWOA puts in motion funds to assist states in the planning and implementation of a responsive design via federal grants. STWOA has a sunset clause at which point federal funding will cease and existing programs will be maintained by the individual state authority. It is estimated that by the year 2000 the percent of unskilled workers needed in the job force will drop by more than half. In 1950, unskilled workers represented 60% of the labor force and it is estimated that by the year 2000 that number will drop to 15% (American Vocational Association, 1994).

The STWOA marks a giant step toward the development of an educational system that matches students' educational attainment and corresponding skills more closely to job opportunities. It also reinforces the need to prepare students with high levels of technical skills and related academic competencies.

The School-to-Work legislation gives states the flexibility and autonomy to design and implement their own programs based on regional economic and labor market needs (American Vocational Association [AVA], 1994).

STWOA has been met with mixed reactions. Backers of this plan see it as the vehicle to provide students much needed skills that will ultimately lead to success in the business arena. Businesses are supportive. Proponents of STWOA see it as a way to support the validity of vocational education classes. "For educators, STWOA means dramatic changes and a revolutionary way of preparing students for the challenges of the 21st century. It means learning new ways of teaching familiar material and connecting it to the workplace" (California Educator, 1997, p. 6).

New technologies have generated increased and varied applications of scientifically based materials in the world of work thereby increasing the importance of science and math knowledge and skills for workers. For

many students, science and math are intimidating subjects. Low achieving and average students tend to shy away from such courses as they represent unfamiliar and difficult concepts. Stereotypic images and expectations, lack of self-confidence, and failure to perceive relevance are some of the reasons that females are so greatly under-represented in courses in mathematics, science, and technology.

Helping students learn more about science and technology and become more skilled at problem solving and analysis has been the goal of recent educational efforts. Many of these initiatives involve the integration of academic subjects with vocational education in a combined curriculum and instructional delivery. In this way, students have the opportunity to apply their academic knowledge to specific occupational tasks and to solving problems typically encountered in business and technical fields (Lankard, 1993, p. 1).

The Vocational Education Target Intervention program piloted programs at Withrow High School that connect and were able to demonstrate for students the relationship between academics and business. Integrated curricula at Withrow High School linked carpentry with language arts and mathematics. Assignments were written with regard to the vocational education project which ultimately affected academic achievement and put students in an active rather than passive learning mode (Cincinnati Public Schools, 1986, p.8).

Catonsville Community College (CCC) and Printing Industries of Maryland and Southern Pennsylvania (PIM+SP) responded to business concerns about deficiencies in basic reading and math skills through a two-fold process. CCC (1993), wrote and conducted a survey that demonstrated the deficiencies to be more than just local, and then they wrote and received grant money to implement basic training programs (p. 9).

Education is the means to an end, but the end is currently in a continual state of fluctuation. Education needs to be on a bidirectional path where not only does the mean justify the end,

but the end justifies the mean. No longer can education be unidirectional and steadfast.

It is important that every student participate in challenging and purposeful studies which blend theory and application. Blended instruction needs to occur for all students at every level of schooling. Learning derived through the performance of tasks and projects encourages the use of information and skills and retention and application of knowledge. Strategies that require systemic change and become an essential part of school improvement planning have the best capacity to forge blended instruction. However, minimally the alignment and modification of the content of academic and occupational curriculum must occur so that coordination exists among courses (Maryland State Department of Education, 1984).

Opponents to STWOA see it as another dream scheme that will only take funding away from existing programs. All too many academicians only see high school academic programming as servicing the A to F students and everyone else is placed in the dumping ground of industrial arts. Industrial arts programs provide much value and they connect.

Existing programs have changed, and a multitude of new programs have emerged as a result of legislation, state reform, business concerns, and technology advocates. Programs that provide relevance through change incorporate integration, collaboration, and connectivity. Technology in all its forms and definitions surrounds everyone and by its very nature is integration, collaboration, and connectivity. "...Change is the key word, and change implies learning. And people today have to keep learning" (California Educator, 1997, as stated by D. Stern). Students can keep learning from the programs that are fashioned similar to academies, career paths or certificate programs, and programs that allow for alternative graduation credits. All of these provide alternatives for students.

Literature Subsection Two

How are programs that integrate vocational and academic classes designed?

Research of the literature shows a variety of programs have emerged as a result, in part, to Goals 2000 and School-to-Work legislation. Programs have become customized according to site application and how such a program will conform to the local socioeconomic makeup. According to Cody (1989), industrial arts plays a viable role in a student's education by increasing retention levels through direct application and bridging a gap between industrial arts and academics (p. 8).

Several programs have been developed, primarily within the past five years, which emphasize the teaching of mathematics and science in industrial arts/technology education. These include: "Technology Education - Mathematics and Science Interface Curriculum Project," developed by the Maryland State Department of Education, Texas' "Interfacing Math, Science and Technology," and others. These programs, and others presently being developed, are becoming models for the teaching of mathematics in a meaningful educational setting (p.19)

Cody (1989) maintains the curriculum guides used by industrial arts instructors show math-related objectives and believes more is actually taught. "...the Architectural Drafting curriculum, where only one math-related objective was found, instructors reported teaching 62 math-related objectives" (p.25). A student's success rate in industrial arts courses is correlated to his success in understanding and applying math concepts (p.29). Roegge and Ferej (1995) write that interviews and observation by Grubb, Davis, Lum, Plihal, and Morgaine(1991) show eight models of integration:

1. The infusion of academic content into existing vocational courses by vocational teachers
2. The infusion of academic content into vocational courses by combinations of vocational and academic teachers
3. The use of vocational applications to illustrate concepts and principles within academic courses

4. The alignment and modification of the content of both the vocational and academic curricula
5. Independent senior-year projects which incorporate skills learned in vocational and academic course work
6. Occupationally oriented academies, or schools-within-schools
7. Occupationally oriented high schools
8. Occupational clusters replacing traditional academic departments within a high school; a combination of occupational clusters and academic departments in a matrix structure (p.1).

Restructuring an educational institution has numerous implications non-the-least of which is agreement on types of programs. Three applications will be described in this subsection; the academy model, career paths or certificate programs, and a program that allows for alternative graduation credit.

"Academies usually operate as schools-within-schools" (Grubb, 1996). At Pasadena High School they have the Pasadena Partnership Academies where academic learning is integrated with vocational education (ALIVE). Throughout the academy programs, Pasadena has:

- Defined entry
- Provided Pre-Academy course
- Incorporated substantial private sector support
- Developed a series of Academies focusing on various occupational fields
- Developed close cooperation also with area college
- Plans to define a specialized diploma

The academy model presents thematic clusters such as computers, finance, health, and communication. The academy model addresses the needs of all students and exposes them to a structured and hierarchical program. All students are required to take core academic classes fulfilling graduation requirements plus the necessary vocational education classes. Academies have a direct line of succession guiding a student to higher education

or possible job placement. All students have an opportunity for internship and apprenticeship (Appendix D).

Academies are the collaborative effort of a team of instructors. The team is typically comprised of an English, math, social science, and vocational education instructor. Through this type of structure, "it becomes fairly easy to integrate vocationally relevant material into academic courses and to coordinate courses" (Grubb, 1996). Another key element of academies is the link between each individual cluster, business, and higher education. Collaboration between all factions maintains a high level of realism and connectivity for all.

The academy model has many clear advantages, then. Evaluations of academies in California indicate that they reduce dropout rates and increase enrollment in post secondary education among students otherwise at risk of dropping out (Grubb, 1996).

Clearly, the Academy model and the necessary restructure involved is not applicable to many sites. Career Paths and Certificate programs on the other hand involve less overall restructuring. Career Paths and Certificate programs can be found at South El Monte High School where their approach to the tenants of Goals 2000 and School-to-Work took on a different look. Students interested in Industrial Technology and Engineering have an option of three separate and distinct career paths: work, certification, and university. Technology class curriculums include subject matter that crosses academic barriers; it is inherent in the framework. "...studies in the technologies can bridge many gaps in the learning process, including those in mathematics and science (Cody, 1989, p.16).

Within the three career paths, students enroll and participate in a diverse program designed for life-long learning (Appendix B) where tech prep courses are blended with academic classes. According to Dugger (1994), numerous comparisons can be made between technology and academics. Such comparisons link technology and science, technology and engineering, and technology and mathematics (p. 7-8).

Technology education should reveal the process of technology as it evolves ideas to fruition. This can best be learned using laboratory

experiences to augment classroom instruction. Likewise, such education should show how technology affects individuals and society.

Technology education should be appropriate to the student's age and experience. It should begin with descriptive material and then involve principles and concepts, incorporating direct experience at all levels.

Technology education that includes social impacts as well as the technics provides the opportunity to integrate the two in newly formulated curricula, possibly making increased use of teaching.

The sciences and mathematics are important to the understanding of the process and meaning of technology. Their integration with the technology education curricula is vital (The Technology Teacher, 1994 from AAAS, p.3).

The open architecture of Goals 2000 and School-to-Work allows for diverse interpretation. The benefit of such a design is the individualism by which a school site may develop a tailor-made program. At Azusa High School, CA, an alternative form of meeting graduation requirements combined wood construction technology and mathematics. Students receive ten credits after successful completion of Basic and Occupation I Wood Construction and upon doing so fulfill two semesters of mathematics for the purpose of graduation. Students gain entry level skills, knowledge of related terminology, and extended mathematics skills as they relate to the world of work. Each unit of instruction is linked to the related mathematics standard(s). Evaluation of student success emanates from interpersonal skills, personal management skills (teacher evaluation), and application skill (student/teacher evaluation).

Programs that integrate technology and academics differ in appearance, presentation style, but not in intent. All programs are professing the importance of the role that integrated programs play in the overall development of a student's high school career. Integration looks good on paper and has the backing of legislation, but its implementation is not without problems.

Literature Subsection Three

Is the integration of vocational and academic classes pertinent to the success and life long learning of all students?

Industrial technology by itself does not provide the necessary education that will ultimately prepare today's student for tomorrow's job no matter how it gets defined and presented. Cooperation and collaboration in the design and development of a "multi direction integration model" (Lipton, 1994, p. 9) should link academics with career vocations as well as across "technology areas" (Lipton, 1994, p. 9). Technology should cease to be an entity in and of itself. "Effective integration requires not only integration among existing curricular areas but across technology areas. Integration across technology subject matter specialties to provide students with a solid technology foundation" (Lipton, 1994, p. 9).

Kolde (1991) suggests that the jobs graduates take on in the future will require increased training and education. The call for integration is necessary in order to meet the needs of the work force and future employee. The focus needs to be for all students, thus, causing a redefining of the traditional. Again, cooperation and collaboration among the factions provides real world application to academic concepts. By giving vocational education "a much broader focus and purpose...vocational education becomes an educational delivery system--not a content area. Vocational education blends and interrelates all the various subject areas into an integrated and comprehensive educational program that emphasizes higher-order thinking and problem-solving skills" (p. 454). Benefits of integration, suggests Kolde (1991), are the quality of organization, the program, and the materials. Student interest and retention is increased due, in part, to relevancy. Education cannot be complacent when the work force it serves is in a continual mode of change.

Business and industry have long recognized the need for employees who possess a solid foundation in the academic basics, who can communicate with and relate to one another, and who are competent in the basic technical skills of the occupation. As the economy has changed its focus from production

to service to information, the composition of the work force has become increasingly diverse, and the scope of required skills has expanded. To meet the needs of the workplace, education must change. The classroom of the future is one that integrates academic and technical knowledge and skills within an applied vocational learning model (p. 455).

"Sometime soon an 'educational think tank' will have the revelation that our children need to be equipped with basic three-dimensional problem-solving and practical skills, Mr. Rannels predicts. At that point the cycle will be complete, as we move ahead into the past" (Rannels, 1990-91). Paper and pencil exams are not the only measure of success. Industrial arts classes address all learning levels and do so through practical skill development. The response by school administrations to low achievement in academic areas is to increase the volume. This happens at the expense of industrial arts, according to Rannels, (1990-91). Vocational education courses do not inhibit life long learning they enhance it.

Forman and Steen (1996) suggest that there are unwarranted myths associated with applied academics and that a good paying job may not require a higher education. If a nail is off center by a sixteenth of an inch will the stud still be secured? Absolutely. What math class allows for a margin of error such as this? None. Applied academics can and should be challenging, thus, vocational education can be for everyone whether they are college bound or not. "...Moreover, modern vocational programs, geared to technology and industrial standards, can provide the same level of rigor to which traditional academic courses aspire. Indeed, the skills required for critical thinking, communication, and teamwork advocated in the academic standards are just what students need to prepare for work in an internationally competitive economy" (p. 33). Skill based learning can provide increased options when students are experiencing uncertainty about their educational future.

But Carl wanted both--to prepare for both a good job and a good college. To do this he worked after school as an apprentice on a construction crew that was building a swimming pool at a nearby hotel. Little did he realize how much mathematics he would need for this job: To lay out the

pool, to meet code specifications, to create attractive designs, to conform to the required quality.

As it turned out, Carl used on this project many of the things he learned in algebra, geometry, and science classes--especially about gathering and recording data, making measurements, calculating answers, and interpreting results. But he learned something else as well: that practice is not the same as theory, that "work work" is not the same as "schoolwork."

In contrast to the rules taught in math class, the reality on the ground is that the diagonals of a rectangle aren't exactly equal, nor are the angles 90 degrees (p. 33).

The structure of education and how it is delivered is going through a metamorphosis prompted by an assortment of business, federal, and state documents advocating a better prepared graduate. Discovering how traditional vocational classes can evolve and become an integral component of this new wave of change is discussed by Grubb (1993). "The efforts to integrate academic and vocational education force teachers to balance the varied capacities--general and specific, 'academic' and 'vocational'--that successful individuals must possess" (p. 27). In order to do this effectively, teachers may need to extend their own learning beyond academic walls and bring work concepts into the classroom. Karen Adams demonstrates this idea.

Karen Adams, a Riverbank High School math and history teacher and an Oakdale District Teachers Association member, spent several weeks in a mentorship program working for the Modesto City Parks and Recreation Department. She was paid for her time by project grant money.

She worked at a golf course, where she designed a survey, administered it and interpreted the results. She says the experience gave her a better understanding of how to tie in mathematics with the reality of the working

world, and explain the relationship to her students (California Educator, 1997, p. 12).

According to California Educator (1997), combining academics and vocational education is something all students need whether or not they are college bound. Infusion of vocational education brings exposure to career possibilities and work related curriculum. Students may be involved with a marketing project that has been developed by them from infancy; a project integrating math, science, and English. All of this means changes are necessary in the way material is presented and lessons delivered. There needs to be the connectivity to the work place. As logical as this may seem, opponents to STWOA see it as another dream scheme that will only take funding away from existing programs (p.6). Industrial technology, in name, has transformed itself numerous times and educators see STWOA as simply another tag. Technology has been referred to as "manual training, manual arts, industrial arts, and now technology education" (Gow, 1995). In actuality, the true essence of the subject matter taught has changed but minutely.

Gow (1995) states, "...what a technology teacher believes should be taught is a direct result of what the teacher believes technology is" (p.48) "...tools--no matter how primitive, no matter how sophisticated, that make a task easier--and the way we use them" (Gow, 1995, as quoted in Tech Directions, 1994) summarizes one perspective concerning a definition of technology. This quote, in response to an inquiry concerning the definition of technology, and how it is interpreted provides the impetus for program delivery.

Technology is applied science. Technology is a knowledge of how to do something. Technology is the means by which we solve society's problems. Technology is the things--objects and artifacts--that we produce. And, of course, technology is tools and the skills needed to use them.

On closer examination, it becomes clear that each of these definitions is based on a key word or thought: applied science, knowledge, problem solving, things, and tools (p. 49).

Educators are transforming programs and moving toward integration as suggested

by Gow (1995) whether or not technology is thought of as an art, a science, or tools and things. Students are now graduating with certificates of proficiency, obtaining on-the-job training through community classroom, working at alternative graduation requirements, and taking advantage of 2 + 2 programs. At Lopez Island High and Middle School, WA, "we have integrated science and technology courses into a single activity-orientated curriculum. The new curriculum has been influenced by current trends in Technology Education, Applied Academics curriculum in science, and Design Technology programs from England" (Adams, 1994). In a Construction Technology program at Alta Loma High School, students can get math credit for taking an estimating course. The Pasadena Partnership Academies patterned after successful models in the United States, Europe, and Japan produce high levels of academic achievement and student retention. South El Monte High School, CA, developed a cross-curricular certificate providing the opportunity for students to receive credit for an assignment in two or more classes. South El Monte has developed school-to-career education plans that address the work bound, certificate , and university bound student (Appendix B).

Summary

Some extraordinarily diverse and creative programs have been developed and others simply redesigned to address the issues set forth in such legislation as the Carl Perkins Act, STWOA, and California's School-to-Careers Plan. Programs blend academics and vocational education showing connectivity between work based learning, school based learning, and relevant activities. Although programs vary depending upon resources and interpretation, the goal(s) remain the same. The education of today's students for the purpose of successfully meeting the challenges of tomorrow is the ultimate goal.

CHAPTER THREE

Methodology

Introduction

Change happens because of a vision. This project is a direct reflection of a vision to integrate drafting and mathematics. The process began through general inquiry of probable interest. In this case, the interest was great. Currently at Nogales High School, Math A is offered and upon completion students should be ready for pre-algebra. Students are not successful with this transition and it was suggested that there should be an interim course between Math A and pre-algebra. Through conversations, the existence of a Math B program emerged. This program was reviewed to identify possible elements that could successfully integrate with mechanical drafting. The population served, curriculum development, and existing programs are discussed in this chapter.

Population Served

The curriculum was developed specifically for students in grades ten through twelve in the Rowland Unified School District. The curriculum is appropriate for all students in grades ten through twelve including the Resource Specialist Program (RSP) and Special Day Class (SDC) program. This curriculum was developed in accordance with district guidelines and state frameworks. This curriculum was developed in cooperation with the math department at Nogales High School and the Mathematics Mentor for Rowland Unified School District.

Curriculum Development

The curriculum development for this project was accomplished with the assistance of the math department and information obtained from the Los Angeles County Office of Education, Downey. Drafting units of instruction were delineated and subsequently linked to the existing math strands. The following two paragraphs provide an overview of the curriculum development process. Specifically, the curriculum structure and content validation process.

Curriculum Structure. This curriculum was developed in accordance with the state framework for drafting communication and the current eighteen week plan and the

seven mathematic strands. The curriculum was developed focusing on a unit, transportation, from the State of California's Math B program. The course outline consists of the following: (1) overview, (2) eighteen week plan, (3) units of instruction, (4) assignments, (5) support material, (6) coordinates, and (7) semester assessment. The material collated was extracted from existing programs, and curriculum instruction used drafting technology as the vehicle to present Math B with an emphasis on transportation. The prerequisite for the course is Math A, but there is no prerequisite for drafting technology.

Content Validation. The content for this curriculum was validated by review. The review panel consisted of the Industrial Technology Department, Mathematic Department Chairperson, and the district Math Mentor.

Existing Programs

An existing program integrating drafting and math in the local area was found at So El Monte HS. However, programs integrating math and technology were found at Azusa HS, and Pasadena HS.

Summary

Chapter Three has provided a description of the process used in the development of the proposed curriculum. The development and design of this project takes into account all students and all learning abilities and modalities. This project design will be reviewed by industrial technology and the math department.

CHAPTER FOUR

Budget

Introduction

The implementation of this project is possible in a large part to the presence of all primary non-consumables and credentialed staff. Nogales High School has in place a 30 station drafting lab with all tables equipped with Vemco drafting arms. Present in the lab is the essential equipment used by drafters; for example: triangles; compasses; dividers; rulers; an assortment of templates; and texts. In addition the lab has in place 19 computer stations. Eighteen of the 19 stations have AutoCAD12 and one station has AutoCAD13. To assist with instruction, the lab has one overhead projector with an In Focus attachment for computer to screen viewing, screen, and wall mounted Vemco blackboard arm. Output is managed using a lazer jet printer and eight pen plotter. The computers are IBM clones and have been upgraded for greatest efficiency in running the current software. For the purposes of this paper, the forgoing budget concerns consumables only and does not include preferred instructional materials.

<u>Consumables</u>	<u>Cost</u>
bond paper	\$ 25.00
drafting tape	7.30
computer disks	3.85
plotter pens (.35, .50, .70)	22.50
plotter pens (assort. colors, pkg)	77.55
ink jet cartridge	35.00
cleanser	9.70
paper towels.	18.05
vellum (9 x 12).	25.85
vellum (12 x 17)	52.85

cleaning supplies (computers and drafting tables)	50.00
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Summary

Chapter Four has provided a description of an existing drafting/computer lab. It has also listed a budget regarding consumable supplies found necessary for implementation and maintenance. It is recommended that a semester budget to maintain this project be \$400.00 to 500.00.

CHAPTER FIVE

Conclusions and Recommendations

Introduction

Included in Chapter Five is a presentation of the conclusions gleaned as a result of completing this project. Further, the recommendations extracted from this project are presented. Lastly, the chapter concludes with a summary.

Conclusions

The literature evaluated for this study validates the questions posed and substantiates the need for continued program development and re-design. Federal and state documentation shows support for the need to restructure education and have vocational education as an integral segment. There is a need to provide for cross-curricular integration because the benefits that are extracted assist students in realizing the link between school and work. California is in fact committed to excellence and to providing the best education possible. Through cooperation and collaboration at all levels and at all sites success can be achieved. Success may take on a totally new look, and old systems may have to be dismantled giving way to new innovations that take the form of academies, career paths, or alternative credits. Success means evaluation of current structures and future goals and the steps that must be put in place to allow it to happen. Change is difficult as is retrofitting the old shop class. Industrial arts teachers know all too well that there will be a continued need for mechanics carpenters, drafters, electricians, and etc... The traditional shop class is quickly becoming a memory. It is being replaced with technology and industrial education which is a more broad application of the old shop class.

This research did identify and study individual programs. This research did not address issues and concerns of site academicians views or research concerning their thoughts about integration with vocational education. Also, this research did not approach the issue of skilled vocational educators and whether or not replacements are found for retirees.

Recommendations

Based upon the findings of this study, the following recommendations are stated as they would relate to Nogales HS.

1. That other site industrial arts courses be reviewed to identify total programs or introductory levels where the integration of math is feasible.
2. That the industrial arts courses offered at Nogales HS address the possibility of providing alternative math credit.

Summary

Industrial arts is an area of instruction that innately provides instruction in math, science, and English. This integrated instruction provides all students connectivity between school and work. As logical as this may seem, integration is very hard to accomplish because not all educators buy-in to the concept.

Change does not happen without consequence and sacrifice. Each school site must collectively evaluate such consequences and sacrifices making sure the means justifies the end and the end the means. Collectively and collaboratively there needs to be sufficient if not total buy-in by all the players. Industrial Arts courses provide enrichment for high achievers as well as the slow achievers. The answer to educational deficiencies may not be in increased academic graduation requirements that put a strangle hold on industrial arts but more an integration of the two. Integrated programs need continued evaluation and financial backing in order to maintain the integrity of just such a program.

APPENDIXES
APPENDIX: A
Project Curriculum

MECHANICAL DRAFTING

MATH B

INTEGRATION

History

The diversity of the needs of graduating Nogales High School students traverses a wide spectrum. In as much as we would like to have all students enter and complete a two-four year college program, the reality is they do not do so. Therefore, we need to provide all students an opportunity to fulfill graduation requirements and be exposed to curriculum rigors as they relate to life's situations.

Purpose

The purpose of this project is two fold. First, it will service all students needing additional math skills. It will provide them a chance "to experience how mathematics is used in design and decision making to solve everyday problems including those dealing with mobility"(TDM). Second, it will provide an alternative means by which students can meet the graduation requirement for mathematics.

Projected Outcome/Evaluation

As stated in the Transportation Demand Management Overview, "the intent is to redesign traditional courses to provide learning opportunities that cause students to formulate and solve problems; criticize their own work; work in teams; communicate about what they are doing; and to achieve mastery of the particular topic, skill or concept they are being exposed to" (TDM). Projected outcome will be measured by quizzes, individual and group work, individual projects, presentation, and portfolio development.

MECHANICAL DRAFTING

MATH B

INTEGRATION

Eighteen week plan

Transportation theme

<u>WEEK</u>	<u>THEME</u>
One.	History -Mechanical Drafting -Transportation
Two.	Orientation and Safety
Three	Careers: -Mechanical Drafting -Transportation
Four.	Equipment
Five - Six.	Measurement
Seven - Ten.	Transportation Choices
Eleven - Seventeen.	Computer Aided Design
Eighteen.	Final Assessment Portfolio Presentation

Unit Outline: History

Objective: Students are exposed to the history of drafting as a graphic language from early drafting tools and implements to the CAD/CAM process used today. The students explore the history of transportation and discover the relationship between drafting and transportation.

Instructional Method:

1. class lecture
2. demonstration
3. discussion
4. video presentation
5. individual instruction

Materials Needed:

1. overhead projector

Student Expectation:

Students outline the evolution of drafting and the transportation industry from primitive efforts to CAD/CAM and the robotic systems of today.

Activities:

1. non-verbal communication
2. the future
3. time line

Academic Skill Enhancement:

1. evaluation
2. coordinate
3. accuracy

Mathematics Strands:

1. numeration
2. language
3. discrete math

Standard

Visual Communications Technology: Drafting 18

Population served: All students, SDC, RSP grades 10 - 12

Evaluation of student work:

1. work completed by due date
2. neatness
3. project message understood
4. evaluation sheets (Rubric)

History -Assignment one

Theme: History

Objective: Introduce to students non-verbal communication through the ages.

Assignment: Read and complete exercises. Help create a “What do Drafters do ?” bulletin board. Answer the question as it relates to the transportation industry.

Procedure:

1. Follow along as the teacher reads pages 2-11 in *Basic Drafting for Design*.
2. Follow along as the teacher reads page 3 in *Basic Technical Drawing*.
3. Follow along as the teacher reads pages 1-2 in *Drafting Fundamentals*.
4. Define the terms on “Vocabulary Checklist”, page 7, *Basic Drafting for Design* and answer “Check your Knowledge”, page 9.

Grade:	neatness	2pts
	on time	2pts
	complete	2pts
	following directions	2pts
	accuracy	2pts

History-Assignment two

Theme: History

Objective: The students become familiar with the progression of two industries, technical drawing and transportation. Integrating these two technical areas, students must envision the transportation of tomorrow and show how these two fields relate.

Assignment: Each group develops a one page essay about their ideas concerning futuristic modes of transportation. It may be necessary to develop a picture(s) in order to completely relay the groups thoughts. Each group is to establish a recorder, presenter, and writer/typist.

Procedure:

1. break-up into assigned groups
2. elect and record officers
3. discuss transportation problems and solutions
4. select one problem and elaborate on what the group feels is a solution.
5. present your group's idea tomorrow
6. hand in a one page report, notes, and necessary drawings.

Grade:	neatness	3pts
	on time	2pts
	complete	2pts
	compliance	3pts

History-Assignment three

Theme: History

Objective: Students visually identify periods of time and connect the time to industrialization and design.

Assignment: Students break into assigned groups and develop their own time line depiction of major developments and breakthroughs.

Procedure:

1. elect a recorder, procurer, and presenter. Everyone is responsible for the assembly of the project.
2. determine major years
3. determine how to represent major developments
4. develop a time line
5. present and discuss the groups time line

Grade:	neatness	3pts
	on time	2pts
	complete	2pts
	accuracy	3pts

Unit Outline-Orientation and Safety

Objective: Students are exposed to all aspects of safety operations involving the use of the commercial equipment they may be required to use.

Instructional Method:

1. class lecture
2. demonstration
3. individual instruction
4. AVID instructor, guest presenter
5. unit quiz

Materials Needed:

1. overhead projector

Student Expectation: Students understand the need for a positive attitude towards safety in the work place by demonstrating safety concepts in their everyday class and shop activities.

Activities:

1. readings and discussion
2. understanding and adhering to safety rules
3. estimating profit and loss

Academic Skill Enhancement

1. cost estimating
 - a. labor
 - b. materials

2. value development
 - a. work habits
 - b. safety
 - c. others
3. analysis
 - a. time management
 - b. job assignments

Mathematics Strands:

1. numeration
2. language
3. logical reasoning

Standard

Visual Communications Technology: Drafting 16, 19

Population served: All students, SDC, RSP grades 10 - 12

Evaluation of Student Work:

1. objective test
2. class and shop behavior
3. estimation sheets

Orientation and Safety-Assignment One

Theme: Orientation and safety

Objective: Students gain a thorough understanding of classroom procedure. Students understand rules and safety, discuss tips for success, and become orientated on room logistics and evacuation procedures. Students gain an understanding of how this affects profit and loss.

Assignment: Students create a general outline to be used each time notes are taken for this class.

Procedure:

1. follow along as the teacher reads *Birth of a Nation* and *Timely Tips for Busy Students*.
2. copy down the format for writing class notes
3. hand in the outline for credit

Grade:	neatness	3pts
	on time	2pts
	complete	2pts
	accuracy	3pts

Orientation and Safety-Assignment two

Theme: Orientation and Safety

Objective: The students gain a thorough understanding of importance and value of maintaining accurate notes.

Assignment: Students use their general outline to take notes on logistics and classroom guidelines.

Procedure:

1. take notes concerning classroom logistics
2. take notes concerning classroom guidelines
3. return guideline signature sheets tomorrow for credit

Grade:	neatness	3pts
	on time	2pts
	complete	2pts
	compliance	3pts

Orientation and Safety- Assignment Three

Theme: Estimating

Objective: The students gain a thorough understanding of how complicity or non-compliance to procedure and safety rules affects profit and loss.

Assignment: Students estimate the effects attendance and safety have on the overall profit margin of a company. Each group will develop a profit and loss sheet.

Procedure:

1. break out into assigned groups and pick a corporate name for the automotive engineering firm.
2. elect a CEO, accountant, and supervisor
3. everyone else in the group is a laborer
4. each laborer is to pick up his/her labor statistics from the teacher.
5. each laborer is to complete a two week time sheet and present it to the supervisor.
6. the supervisor is to check the data, initial the card, and forward the cards to the accountant.
7. the accountant is to develop a profit and loss sheet and forward it to the CEO
8. the CEO has a press conference--the class

Grade:	neatness	2pts
	complete	2pts
	accuracy	6pts

Unit Outline-Careers

Objective: The student is exposed to the variety of job opportunities available within the transportation and visual communications field.

Instructional Method:

1. class lecture
2. guest speaker
3. discussion
4. individual instruction

Materials Needed:

1. overhead projector

Student Expectation: The student develops a career matrix analyzing a specific job and accurately outlines a directional track.

Activities:

1. readings and chapter questions
2. interest survey
3. research and career matrix

Academic Skill Enhancement:

1. evaluate tables and graphs
2. explore options
3. investigate and communicate skills

Mathematics Strands:

1. numeration
2. language
3. statistics

Standard

Visual Communications Technology: Drafting 17, 41

Population served: All students, SDC, RSP grades 10 - 12

Evaluation of student work:

1. completed project

Careers - Assignment One

Theme: Careers

Objective: Introduce students to career options within the drafting field as they relate to the transportation industry.

Assignment: Each student is responsible for the information on pages 15-17, *Basic Technical Drawing*; pages 1-13, *Drafting Fundamentals*; and the review questions, page 14, in *Drafting Fundamentals*.

Procedure:

1. Obtain page 15-17 from the teacher. Follow along as the teacher reads pages 15-17, *Basic Technical Drawing* and pages 1-13, *Drafting Fundamentals*.
2. complete the review questions on page 14
3. hand in the review questions for credit

Grade:	neatness	3pts
	on time	2pts
	complete	2pts
	compliance	3pts

Careers - Assignment Two

Theme: Careers

Objective: Provide all students an opportunity to explore possible alternative career options through the use of an interest survey.

Assignment: Each student will take the COPS interest survey or a similar survey.

Procedure:

1. obtain the COPS survey from the teacher
2. use a number 2 pencil to bubble in all responses
3. turn in the completed survey for credit

Grade:	neatness	3pts
	on time	2pts
	complete	2pts
	compliance	3pts

Careers - Assignment Three

Theme: Careers

Objective: Provide all students an opportunity to explore possible alternative career options as identified from the COPS interest survey.

Assignment: Each student selects one of the career option identified from the COPS survey and researches the required course work. From the gathered information, develop a career matrix.

Procedure:

1. write down the career options identified from the COPS interest survey
2. select one of the careers to further explore
3. develop a career matrix
4. hand in the matrix for credit

Grade:	neatness	3pts
	on time	2pts
	complete	2pts
	compliance	3pts

Unit Outline-Equipment

Objective: The student understands the correct names and uses of drafting equipment, is familiar with the media used in completing a drawing, and understands the proper drafting techniques. The knowledge learned is applied to developing and understanding real costs through various types of charts and graphs.

Instructional Method:

1. class lecture
2. demonstration
3. discussion
4. work sheets
5. individual instruction
6. vocabulary (charts)
7. percent/decimal conversion

Materials Needed:

1. overhead projector
2. samples

Student Expectation: The student analyzes data and plans a methodological procedure to accurately show the results.

Activities:

1. bar chart
2. pie chart
3. line graph

Academic Skill Enhancement:

1. dimensional analysis
 - a. gasoline cost in dollars per day
2. Analysis
 - a. cost factors other than gasoline
3. estimating/comparison

Mathematics Strands:

1. numeration
2. language
3. statistics
4. discrete math
5. algebra

Standard

Visual Communications Technology: Drafting 19

Population served: All students, SDC, RSP grades 10 - 12

Evaluation of Student Work:

1. completed projects
2. evaluation sheet

Equipment-Assignment One

Theme: Equipment

Objective: The student applies drafting skills to the development of charts. Information for the charts will come from data concerning gasoline costs in dollars per day, cost factors other than gasoline, and comparisons.

Assignment: Each student develops a line graph from the information provided concerning grades of gasoline.

Procedure:

1. copy the information from the board
2. obtain a sheet of bond drawing paper
3. align the scales
4. tape the bond paper to the drafting table
5. develop the X and Y axis and label them according to the information provided
6. plot and connect the points
7. hand in the graph for credit

Grade:	neatness	3pts
	on time	2pts
	complete	2pts
	compliance	3pts

Equipment-Assignment Two

Theme: Equipment

Objective: The student applies drafting skills to development of charts. Information for the charts will come from data concerning cost factors other than gasoline for the operation of an automobile.

Assignment: Each student develops a bar graph from the informational essay provided. The essay contain pertinent information about all additions costs in order to own operate and run an automobile in California.

Procedure:

1. copy the information from the board
2. obtain an informational essay from the teacher
3. obtain a sheet of bond drawing paper
4. align scales
5. tape the bond paper to the drafting table
6. develop the X and Y axis and label them according to the information provided.
7. develop a bar graph
8. hand in for credit

Grade:	neatness	2pts
	on time	2pts
	complete	2pts
	compliance	2pts

Equipment-Assignment Three

Theme: Equipment

Objective: The student applies drafting skill to develop a pie chart. Information for the pie chart(s) will be obtained from a teacher generated survey concerning driving habits.

Assignment: Each student develops a pie chart(s) from the information provided concerning driving habits and analyzes the information to determine trends.

Procedure:

1. obtain a copy of the teacher generated survey
2. obtain a sheet of bond drawing paper
3. tape the bond paper to the drafting table
4. use a compass or template to create a circle
5. convert the values to percentages
6. develop a pie chart according to the information provided
7. use appropriate labels
8. provide a one paragraph discussion of the results
9. hand in chart for credit

Grade:	neatness	3pts
	on time	2pts
	complete	2pts
	compliance	3pts

Unit Outline - Measurement

Objective: The student understands the importance of measuring systems and the measuring instruments involved in drafting and related fields. The student reviews fractions, decimals, and percentages. The student develops an understanding of the mechanical, architectural, and metric scale.

Instructional Method:

1. class lecture
2. demonstration
3. discussion
4. work sheets
5. individual instruction
6. group and peer collaboration

Materials Needed:

1. scales
2. hand-out "how to read a ruler"
3. overhead projector

Student Expectation: Students estimate and measure with 70% accuracy or better.

Activities:

1. distance between points
2. best route
3. converting decimals and fractions

Academic Skill Enhancement:

1. sequencing
2. basic operational math
3. analysis

Mathematics Strands:

1. numeration
2. language
3. geometry
4. statistics

Standard

Visual Communications Technology: Drafting 20

Population served: All students, SDC, RSP grades 10 - 12

Evaluation of Student Work:

1. completed projects
2. evaluation sheet

Measure Assignment One

Theme: Measurement

Objective: The student is able to convert decimals and fractions.

Assignment: Each student determines the fractional value for all decimals in column A as listed on the front board. Each student determines the decimal equivalent of the fractions listed on the board under column B to two places.

Procedure:

1. copy the information from the board
2. use a sheet of binder paper
3. fold the sheet so the edge with the three holes on the left side is even with the right side edge.
4. label the left side "Column A" and label the right side "Column B"
5. for column A, write the first decimal and provide the answer on the same line
6. for column B, write the first fraction and provide the answer on the same line
7. complete all values as listed on the front board
8. hand in for credit

Grade:	neatness	2pts
	on time	2pts
	complete	2pts
	accuracy	2pts
	compliance	2pts

Measure Assignment Two

Theme: Measurement

Objective: The student determines the best route to travel.

Assignment: Each student is given a group assignment. Each group will determine the best route (total distance) by which they can travel from point A to point B in the least amount of time for four problems.

Procedure:

1. obtain the first problem
2. follow along as the teacher reads the problem
3. determine the distance between point A and B
4. determine the best route according to the guidelines
5. obtain the next problem and follow steps 3-5

there are four problems to be turned in

Grade:	neatness	3pts
	on time	2pts
	complete	2pts
	compliance	3pts

Unit Outline - Lettering

Objective: Introduction to and practice of lettering techniques.

Instructional Method:

1. class lecture
2. demonstration
3. discussion
4. work sheets
5. individual instruction
6. vocabulary

Materials Needed:

1. overhead projector
2. Ames lettering guides

Student Expectation: The student accurately and neatly completes a job application form, lettering work sheet, and associated vocabulary.

Activities:

1. vocabulary and check your knowledge
2. lettering work sheet
3. job application/time sheet

Academic Skill Enhancement:

1. language

Mathematics Math Strands:

1. discrete math
2. algebra
3. numeration

Standard

Visual Communications Technology: Drafting 66

Population served: All students, SDC, RSP grades 10 - 12

Evaluation of Student Work:

1. applied test
2. work sheets

Lettering Assignment One

Theme: Lettering

Objective: Introduce all students to correct lettering techniques, vocabulary, and tool usage.

Assignment: Each student reads unit three on lettering, responds to “Check your Knowledge”, page 34, defines each “Vocabulary Checklist” statement, page 35, and answers “Unit Review” questions, page 37.

Procedure:

1. get a copy of Unit Three from the teacher
2. follow along as your teacher reads the chapter
3. complete “Check Your Knowledge”, “Vocabulary”, and “Unit Review”
4. hand in tomorrow at the beginning of class

Grade:	neatness	4pts
	on time	2pts
	complete	2pts
	compliance	2pts

Lettering -Assignment Two

Theme: Lettering

Objective: All students are introduced to proper mechanical drafting lettering techniques for the formulation of vertical letters.

Assignment: Each student practices lettering skills by completing an exercise on vertical letters.

Procedure:

1. Get a copy of exercise one from the teacher
2. take notes as the teacher discusses the directions.
3. be sure to ask questions if you do not understand
4. be prepared to respond to teacher directed questions
5. hand in tomorrow at the beginning of class

Grade:	neatness	3pts
	on time	2pts
	complete	2pts
	compliance	3pts

Lettering-Assignment Three

Theme: Lettering

Objective: Students are to practice learned lettering techniques

Assignment: Each student completes a job application using block letters as practiced

Procedure:

1. follow along as the instructor reads the form
2. take notes concerning the parts of this application that get special notation.
3. complete the application
4. hand in tomorrow for credit

Grade:	neatness	5pts
	on time	1pts
	complete	2pts
	compliance	2pts

Unit Outline-Transportation Choices

Objective: Introduction of transportation choices as it relates to best route, mode of transportation, and gasoline efficiency.

Instructional Method:

1. class lecture
2. demonstration
3. group work
4. vocabulary
5. work sheets
6. miles and kilometer conversion

Materials Needed:

1. overhead projector
2. world globe
3. local city maps
4. Ames lettering guide

Student Expectation: The student accurately and neatly completes charts and determines the most efficient means and route to travel.

Activities:

1. determine distances
2. time and distance
3. total cost of an activity

Academic Skill Enhancement:

1. comparing values
2. review of functions

Mathematics Strands:

1. numeration
2. language
3. discrete mathematics
4. statistics

Standard

Visual Communications Technology: Drafting 20, 21

Population served: All students, SDC, RSP grades 10 - 12

Evaluation of Student Work:

1. daily work
2. applied quiz

Transportation Choices-Assignment One

Objective: Students calculate actual distance between points. Students will learn about miles and kilometers.

Assignment: Each student will calculate round trip distances in miles and kilometers for each route identified on the attached chart. Students will use learned lettering techniques when making all entries.

Procedure:

1. follow along as the teacher reads the instructions
2. take notes for understanding
3. complete the distance chart
4. hand in tomorrow at the beginning of class

Grade:	neatness	5pts
	on time	1pts
	complete	2pts
	compliance	2pts

Transportation Choices-Assignment Two

Theme: Transportation Choices

Objective: Students calculate actual distances based on predetermined destinations.

Assignment: Each student calculates and records the round trip distance between points on a street map.

Discussion: Relationship between time and distance

Procedure:

1. get a copy of a map from the teacher
2. follow along as the teacher reads the instructions
3. select four locations you can reach in one day
4. select four location you can reach in two days
5. select four locations you can reach in a one week trip
6. complete the distance chart
7. hand in at the beginning of class, tomorrow

Grade:	neatness	3pts
	on time	2pts
	complete	2pts
	compliance	3pts

Transportation Choices-Assignment Three

Theme: Transportation Choices

Objective: Students identify fees and hidden costs that become a part of the total expense.

Assignment: Each student calculates and records approximate travel time and related costs that Mel will incur when he drives to each of the listed recreational locations.

Procedure:

1. follow along as the teacher reads the instructions
2. take notes as necessary for understanding
3. complete the chart(s) including dollars per mile
4. hand in at the beginning of class, tomorrow

Grade:	neatness	3pts
	on time	2pts
	complete	2pts
	compliance	3pts

Unit Outline--Estimating

Objective: Students estimate approximate costs and then determine actual costs of a total travel package.

Instructional Method:

1. class lecture
2. demonstration
3. discussion
4. practice work sheets
5. vocabulary

Materials Needed:

1. overhead projector
2. Ames lettering guide

Student Expectation: Students determine overall costs and neatly record the values onto charts. Students estimated and actual figures are within a predetermined tolerance.

Activities:

1. comparing choices of transportation
2. comparing rates and services

Academic Skill Enhancement:

1. estimating
2. comparing values

Mathematics Strands:

1. numeration
2. language
3. discrete math

Standard

Visual Communications Technology: Drafting 21

Population served: All students, SDC, RSP grades 10 - 12

Evaluation of Student Work:

1. completed work
2. applied quiz

Estimating-Assignment One

Theme: Estimating

Objective: Students determine the best transportation mode by estimating various costs then comparing estimate to true values.

Assignment: Each student calculate and records the best choice of transportation for three travelers.

Procedure:

1. follow along as the teacher reads the instructions
2. take notes as necessary
3. estimate and record three totals
4. determine and record actual cost
5. hand in at the beginning of class, tomorrow

Grade:	neatness	3pts
	on time	2pts
	complete	2pts
	compliance	3pts

Estimating-Assignment Two

Theme: Estimating

Objective: Students determine the best airline rates and services.

Assignment: Each student calculates and records the best choice of airline fares and services. Each student identifies highest, lowest, and special fares and writes a one paragraph memo evaluating the findings.

Procedure:

1. separate into teams of five
2. select a coordinator, recorder, and 3 researchers
3. follow along as the teacher reads the instructions
4. take notes as necessary
5. complete the chart
6. hand in at the beginning of class, tomorrow

Grade:	neatness	3pts
	on time	2pts
	complete	2pts
	compliance	3pts

Unit Outline-Map Coordinates

Objective: Students discover the relevance of map coordinate values in locating specific points.

Instructional Method:

1. class lecture
2. vocabulary
3. practice work sheets
4. discussion
5. demonstration

Materials Needed:

1. overhead projector
2. atlas
3. local city maps
4. USGS maps

Student Expectations: The student accurately locates predetermined locations within defining grids, accurately. The student is familiar with related nomenclature and correctly labels a map.

Activities:

1. map nomenclature
2. locating places

Academic Skill Enhancement:

1. math
2. language

Mathematics Strands:

1. numbers
2. spatial manipulation
3. discrete math
4. geometry

Standard

Visual Communications Technology: Drafting 7, 20, 21

Population served: All students, SDC, RSP grades 10 - 12

Evaluation of Student Work:

1. direct application through observation
2. completed work

Map Coordinates-Assignment One

Theme: Map Coordinates

Objective: Students locate city locations using grid coordinates and record the correct response using correct lettering techniques.

Assignment: Each student identifies coordinate nomenclature and X,Y axis by completing the worksheets.

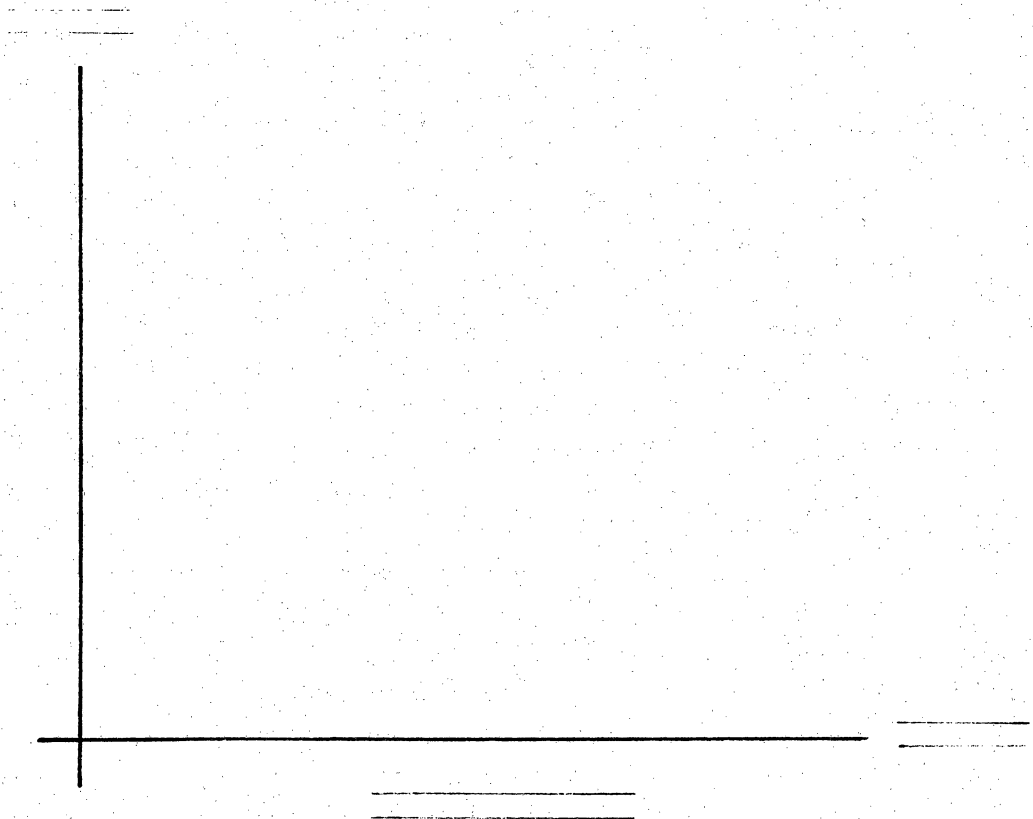
Procedure:

1. get a copy of worksheet one and two
2. follow along as the teacher reads the directions
3. take notes as necessary
4. check your answer
5. hand in at the end of class

Grade:	lettering/neatness	3pts
	on time	2pts
	complete	2pts
	compliance	3pts

Map Coordinates-Worksheet 1.1

Directions: In the space provided, identify and properly label the parts of the graph shown. Lettering quality is a portion of your grade.



Map Coordinates-Worksheet 1.2

Directions: Create a world globe using materials of your choosing. Label latitude and longitude. Identify the location of Los Angeles, California; Moscow, Russia; Washington DC, USA; Rio de Janeiro, Brazil; Lima, Peru; Paris, France; London, England; Berlin, Germany; Jamestown, South Africa; Madrid, Spain; and Managua, Nicaragua. Record the longitude and latitude on a separate sheet of lined binder paper for each city mentioned. The quality of your lettering is a portion of your grade.

Map Coordinates-Assignment Two

Theme: Map Coordinates

Objective: Students improve skills identifying location coordinates.

Assignment: Each student locates the particular cities as identified on the following worksheets and determines the correct coordinate grid.

Procedure:

1. obtain a copy of worksheet 2.1, 2.2, and 2.3
2. follow along as the teacher reads the directions
3. take notes as necessary
4. check your answers
5. hand in at the end of class

Grade:	neatness/lettering	3pts
	on time	2pts
	complete	2pts
	compliance	3pts

Map Coordinates-Worksheet 2.1

Directions: Get a copy of the Colorado map. For each city in column A, identify the corresponding map grid. Place the grid coordinates in column B

A

B

Example:

1. Steamboat Sprs

1. 3, A

Exercise:

2. Lamar

2. .

3. Durango

3.

4. Denver

4.

5. Sterling

5.

6. Glenwood

6.

7. Salida

7.

8. Antonito

8.

9. Campo

9.

10. Collins

10.

Map Coordinates-Worksheet 2.2

Directions: Get a copy of the Kansas Map. For each city in column A,, identify the cooresponding map grid. Place the grid coodinates in column B.

A

B

Example:

1. Wichita

1. 5, D

Exercise:

2. St. Francis

2.

3. Sedan

3.

4. Haven

4.

5. Seneca

5.

6. Oswego

6.

7. Concordia

7.

8. Minneola

8.

9. Lebanon

9.

10. Hays

10.

Map Coordinates-Worksheet 2.3

Directions: Get a copy of the California map. For each city in column A, identify the corresponding map grid. Place the grid coordinates in column B.

A

B

Example:

1. Chico

1. 3, C

Exercise:

2. San Diego

2.

3. Madera

3.

4. Baker

4.

5. Brawley

5.

6. Bishop

6.

7. Burney

7.

8. Alturas

8.

9. Arcata

9.

10. Crescent

10.

Unit Outline-CAD

Objective: Students determine X and Y coordinate values as they apply to the development of a computer generated drawing. Students document coordinate values with learned lettering techniques.

Instructional Method:

1. class lecture/vocabulary
2. handouts
3. discussion
4. work sheets

Materials Needed:

1. overhead projector
2. worksheets
3. metric grid sheets

Student Expectation: Students determine the X and Y values of an object based on a random start value. From the determined coordinate values, each student develops a computer generated drawing based on the predetermined values.

Activities:

1. Absolute values, T-chart and drawing
2. Absolute values, T-chart and drawing
3. Absolute values, T-chart and drawing

Academic Skill Enhancement:

1. Math
2. language

Mathematics Strands:

1. numbers
2. algebra
 - a. coordinate systems
 - b. absolute values
3. spatial manipulation

Standard

Visual Communications Technology: Drafting 6, 7, 8, 9, 14

Population served: All students, SDC, RSP grades 10 - 12

Evaluation of Student Work:

1. direct observation
2. finished work

CAD-Assignment One

Theme: CAD

Objective: Students develop a drawing using X and Y coordinate values.

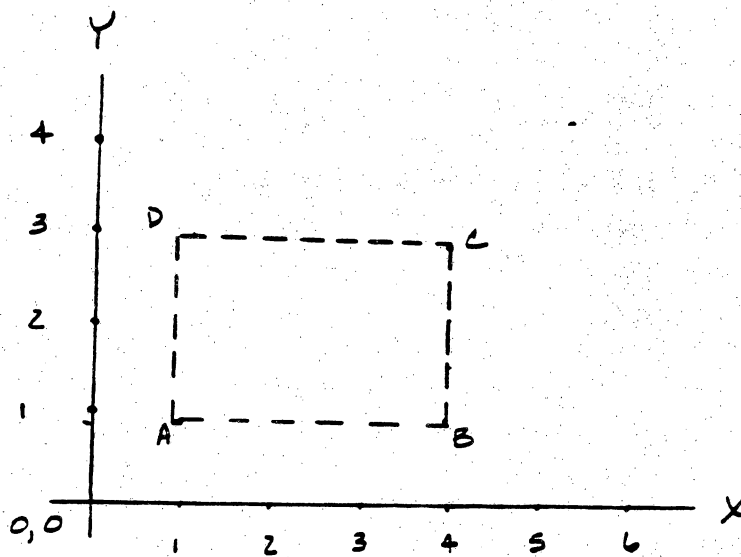
Assignment: Each student determines the necessary coordinates in order to develop the problem shown. List the values on a separate sheet of paper.

Procedure:

1. determine and record coordinate values on a separate sheet of binder paper
2. check your answers
3. find an open computer station
4. turn on the monitor
5. turn on the harddrive
6. wait for the drawing screen to appear
7. look for the word **COMMAND:**
8. type **L** [RETURN]
to point: enter your **X** and **Y** value for point A.
make sure you use a comma between the values [RETURN]
to point: B values [RETURN]
to point: C values [RETURN]
to point:D values [RETURN]
to point: A values [RETURN]
to point: [RETURN]
9. at the command prompt type **SAVE** [RETURN]

CONGRATULATIONS, YOU ARE DONE

Grade:	T-Chart	3pts
	compliance	2pts
	accuracy	5pts



	X	Y
PT A		
PT B		
PT C		
PT D		
PT A		
PT		

SAVE AND PLOT

CAD-Assignment Two

Theme: CAD

Objective: Students develop a drawing using X and Y coordinate values.

Assignment: Each student determines the necessary coordinates in order to develop the problem shown. List the values on a separate sheet of paper

Procedure:

1. determine and record coordinate values on a separate sheet of binder paper
2. check your answers
3. find an open computer station
4. turn on the monitor
5. turn on the harddrive
6. wait for the drawing screen to appear
7. look for the word **COMMAND:**
8. type **L** [RETURN]
 - to point: enter your **X** and **Y** value for point A.
make sure you use a comma between the values [RETURN]
 - to point: B values [RETURN]
 - to point: C values [RETURN]
 - to point: D values [RETURN]
 - to point: E values [RETURN]
 - to point: F values [RETURN]
 - to point: G values [RETURN]

to point: H values [RETURN]

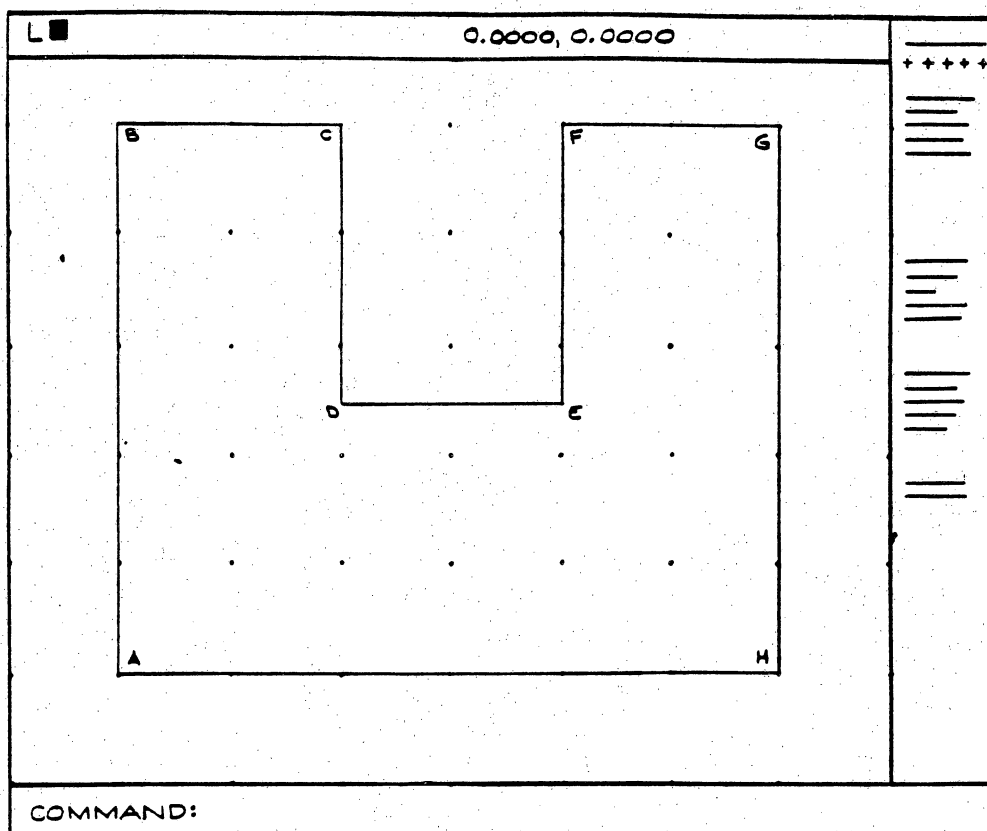
to point: A values [RETURN]

to point: [RETURN]

9. at the command prompt type **SAVE** [RETURN]

CONGRATULATIONS, YOU ARE DONE

Grade:	T-chart	3pts
	compliance	2pts
	accuracy	5pts



	X	Y
PT A		
PT B		
PT C		
PT D		
PT E		
PT F		
PT G		
PT H		
PT A		
PT		

SAVE AND PLOT

CAD Assignment Three

Theme: CAD

Objective: Students develop a drawing using X and Y coordinate values.

Assignment: Each student determines the necessary coordinates in order to develop the problem shown. List the values on a separate sheet of paper.

Procedure:

1. determine and record coordinate values on a separate sheet of binder paper
2. check your answers
3. find an open computer station
4. turn on the monitor
5. turn on the harddrive
6. wait for the drawing screen to appear
7. look for the word **COMMAND:**
8. type **L** [RETURN]

to point: enter your **X** and **Y** value for point A.

make sure you use a comma between the values [RETURN]

to point: B values [RETURN]

to point: C values [RETURN]

to point: D values [RETURN]

to point: E values [RETURN]

to point: F values [RETURN]

to point: G values [RETURN]

to point: H values [RETURN]

to point: J values [RETURN]

to point: K values [RETURN]

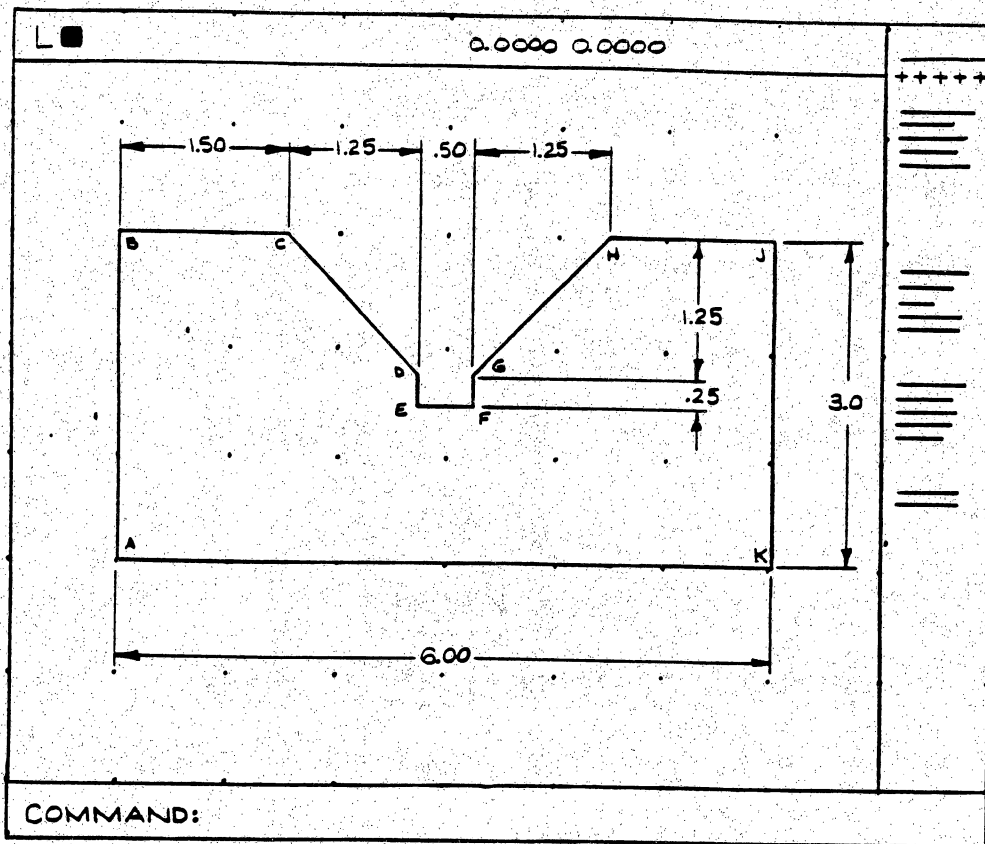
to point: A values [RETURN]

to point: [RETURN]

9. at the command prompt type **SAVE** [RETURN]

CONGRATULATIONS, YOU ARE DONE

Grade:	T-chart	3pts
	compliance	2pts
	accuracy	5pts



	X	Y
PT A		
PT B		
PT C		
PT D		
PT E		
PT F		
PT G		
PT H		
PT J		
PT K		
PT A		
PT		

SAVE AND PLOT

Transportation-Test

Class: Mechanical Drafting and Mathematics

Theme: Transportation application

Prompt: Mrs Scott will be traveling from Nogales High School to Chico, California, this summer to visit with family and friends. She plans to drive and will need to know best route and distance, gas mileage, and expected automobile wear. Mrs Scott also needs information on alternative routes and modes of transportation should she choose not to drive. Mrs Scott will be traveling with a beautiful gray cat, Mrs Gray. Mrs Scott and Mrs Gray truly enjoy nice scenery because it helps make a long trip short or at least it seems so. Mrs Scott owns a 1996 Honda Accord, Six cylinder.

Assignment: Mrs Scott has hired you as a top notch travel agent to determine and formulate a complete itinerary for this trip. If you are an “A”, you are to assume that money is not object. If you are a “B”, the emphasis needs to be on nice scenery. If you are a “C”, you need to develop an itinerary that is very economical. Document all your findings. Summarize your results using excellent mechanical drafting lettering techniques. Present your findings in a report folder.

Some things to consider and include:

- | | | |
|------------------|-----------------------|---------------|
| 1. mileage | 2. miles/gal | 3. hours/day |
| 4. cat | 5. food | 6. hotels |
| 7. airlines | 8. connecting flights | 9. best route |
| 10. scenic route | | |

Grade:	lettering	25pts
	presentation	25pts
	feasibility	25pts
	on time	25pts

APPENDIX: B
South El Monte High School

SCHOOL-TO-CAREER EDUCATION PLAN @ SEMHS
for THREE INDUSTRIAL TECHNOLOGY & ENGINEERING STUDENTS

<i>work based</i> "Vemco"	<i>Certificate person</i> "Condo"	<i>Unit: based</i> "Metro"
Detailer	Architectural Drafter	Civil Engineer
Grade - 9th	Grade - 9th	Grade - 9th
1. English1 (Int App Com) 2. Science 3. Math A (Int App Math) 4. Physical Education 5. Ind/Bus Tech Core 6. Art 1 or Fine Arts Advisory(Self awareness)	1. English1 (Int App Com) 2. Science 3. Math A (Int App Math) 4. Physical Education 5. Ind/FCS Tech Core 6. Art 1 Advisory(Self awareness)	1. English1 (Int App Com) 2. Science - Biology 3. Math - Alegbra 1 4. Physical Education 5. Ind/Bus Tech Core 6. Foreign Language 1 Advisory(Self awareness)
Grade - 10th	Grade - 10th	Grade - 10th
1. English 2(Int App Com) 2. World Hist. & Geog. 3. Math B (Int App Math) 4. Physical Education 5. H&S/Relationships 6. Intro. to Drafting Advisory(Career Path Awareness, Education & Career Opportunities and Peer Pressure) Selects a Career Path	1. English 2(Int App Com) 2. World Hist. & Geog. 3. Algebra I 4. Physical Education 5. H&S/Relationships 6. Intro. to Drafting Advisory(Career Path Awareness, Education & Career Opportunities and Peer Pressure) Selects a Career Path	1. English 2(Int App Com) 2. World Hist. & Geog. 3. Math - Geometry 4. Physical Education 5. H&S/Relationships 6. Foreign Langauge 2 Advisory(Career Path Awareness, Education & Career Opportunities and Peer Pressure) Selects a Career Path
Grade - 11th	Grade - 11th	Grade - 11th
1. English3*(Int AppCom) 2. U.S. History 3. Science(Int App Bio/Che) 4. Drafting Occupation 2 5. Art 2 6. ROP-C A Drafting Advisory(Personal Choices) *Career Research Paper required	1. English3*(Int AppCom) 2. U.S. History 3. Science(Int App Bio/Che) 4. Drafting Occupation 2 5. Math - Geometry 6. ROP-C A Drafting Advisory(Personal Choices) *Career Research Paper required	1. English3*(Int AppCom) 2. U.S. History 3. Science - Chemistry 4. Algebra 2 5. Intro. to Drafting 6. Foreign Langage 3 Advisory(Personal Choices) *Career Research Paper required
Grade - 12th	Grade - 12th	Grade - 12th
1. English4*(Int AppCom) 2. Economics/Gov't 3. Guitar 4. Drafting Occupation 3 5. Ind Tech Lab Ass't 6. RHC- Intro Arch 115 Advisory(Post Grad Plan) *Senior project related to career path.	1. English4*(Int AppCom) 2. Economics/Gov't 3. Art 1 4. Drafting Occupation 3 5. ROP-Building Remod. 6. RHC-Intro Arch 115 Advisory(Post Grad Plan) *Senior project related to career path.	1. English4*(Int AppCom) 2. Economics/Gov't 3. ICM (Trig) 4. Drafting Occupations 5. Science - Physics 6. Fine Arts Advisory(Post Grad Plan) *Senior project related to career path.

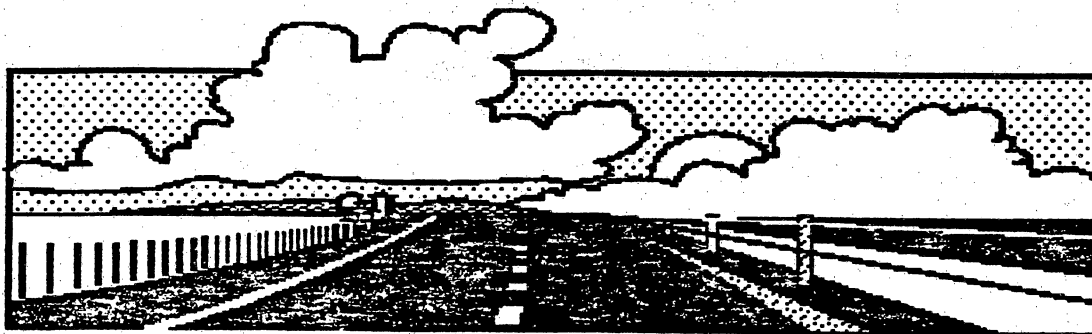
Taking 'requirements' in summer school (ie. H&S, Science, Soc. Sci.), students would free up yearly schedule for additional electives (ie. Commercial Art, Computer Business Skills, etc.)

Each Program must be integrated in academic classes

IT SFO kp10/94

Take hold of the driver's wheel with a CCC.

Students can now share an assignment in other classes for bonus points.



Here's how it works. Lets say you're given an assignment to research and report on a topic. Once you begin your research, think if the topic might be used in another class. Check with the teacher who gave you the assignment to see if he or she will let you use your paper for extra credit or bonus points in another class. The topic must be related to something you have studied or will study in your other class. Check with the teacher for approval that your assignment can be used in his class also. If both teachers agree that the topic can be used in both classes, have the teacher who gave you the assignment grade it, and attach the Cross-Curricular Certificate (CCC) filled out by them. Now, give the same assignment to your other teacher for them to read and issue points or raise a grade.

- **Integrate various areas of study into your work.**

- **Receive credit for an assignment in two or more classes.**

- **Discover how your classes are related to one another.**

- **Become actively involved in your acquisition of knowledge**

SOUTH EL MONTE HIGH SCHOOL
Cross-Curricular Certificate
CCC

This is to certify that _____ has satisfied all the requirements in his/her _____ class for this (Circle one) Report, Project, Drawing, Production, or Other _____

Earned Grade _____ Teachers Signature _____

SB
1882

South El Monte High School
1992 Integration Project

APPENDIX: C
Azusa High School

11

1

[illegible]

WOOD CONSTRUCTION TECHNOLOGY

EVALUATION SHEET

SKILL UNIT COMPLETED	HOURS ON TASK	POINTS POSSIBLE	POINTS EARNED	DATE FINISHED
Orientation	4	100	_____	_____
Safety	10	115	_____	_____
Planning and Design	5	105	_____	_____
Hand Tools	2	85	_____	_____
Portable Power Tools	5	90	_____	_____
Machine Usage	10	105	_____	_____
Measurement and Layout	10	115	_____	_____
Joints	10	95	_____	_____
Gluing and Clamping	1	80	_____	_____
Fasteners and Hardware	3	70	_____	_____
Abrasives	2	70	_____	_____
Print Reading	10	90	_____	_____
Sub-System Assembly	10	80	_____	_____
Finishes and Coatings	3	65	_____	_____
Materials	15	100	_____	_____
Veneers	2	75	_____	_____
Construction Estimating	5	75	_____	_____
Hardware Applications	2	70	_____	_____
Mass Production	20	105	_____	_____
Interior Finishing	3	77	_____	_____
Construction Management	5	75	_____	_____

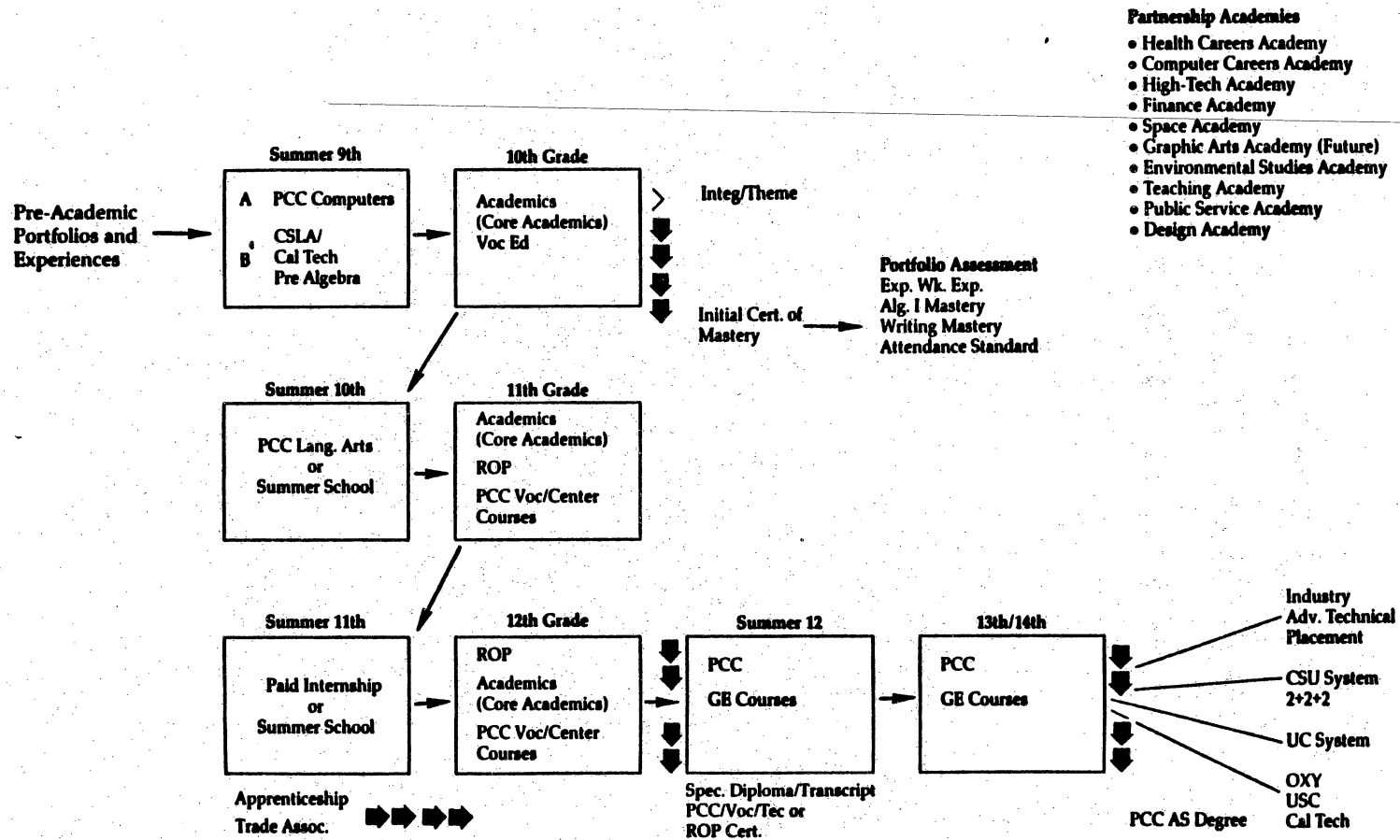
STUDENT MUST PASS WITH 60% OR BETTER TO COMPLETE SECTION

APPENDIX: D
Pasadena High School

PASADENA UNIFIED SCHOOL DISTRICT

Academic Learning Integrating Vocational Education (A.L.I.V.E.)

The Pasadena Model



Partnership Academies

- Health Careers Academy
- Computer Careers Academy
- High-Tech Academy
- Finance Academy
- Space Academy
- Graphic Arts Academy (Future)
- Environmental Studies Academy
- Teaching Academy
- Public Service Academy
- Design Academy

REFERENCES

- American Vocational Association. (1994). School-to-work opportunities act overview. Alexandria, VA: American Vocational Association.
- California Educator California Teachers Association. (1997, February). The 4 r's: Reading, 'riting 'rithmetic and relevance, 1, (4), 6-13.
- Catonsville Community College, MD. (1993). Skills today for tomorrow A workplace literacy consortium for the printing industry. Office of Vocational and Adult Education Washington, DC. (ERIC Document Reproduction Service No. ED 355 367)
- Cincinnati Public School. (1986). Applied academics. Cincinnati Public Schools, Ohio Division of Student Services. (ERIC Document Reproduction Service No. ED 286 750)
- Cody, W. Ed.D. (1989). Identification of mathematics competencies taught in industrial arts/technology education programs in louisiana high schools. Northwestern State Univ., Natchitoches, LA. (ERIC Document Reproduction Service No. ED 355 502)
- De Kalb. (1992). PHYS-MA-TECH. An integrated partnership. Northern Illinois Univ. (ERIC Document Reproduction Service No. ED 355 366)
- Dugger, W. (1994, April). The relationship between technology, science, engineering, and mathematics. The Technology Teacher. 53 (7), 5-8.
- Maryland State Department of Education. (1994). Making high school work through blended instruction. Maryland State Department of Education. (ERIC Document Reproduction Service No. ED 360 483)
- Forman, S. & Steen, L. (1996). Applied academics myths and realities. Education Weekly, XVI (7), 33.
- Gow, G. (1995 September). What is technology? Tech Directions, 48-50.
- Grubb, N. (1993, Winter). Tech prep/applied academics: Integrating academic and vocational education. Tech Directions, 26-27.
- Kolde, R. (1991). Integrated learning for a competitive work force. Kappan, 72, 453-455.
- Lankard, B. (1993). Integrating science and math in vocational education. (Digest NO. 134). Columbus, Ohio: Center on Education and Training for Employment The Ohio State University. (ERIC Document Reproduction Service No. ED 355 456).
- Linz, E., Maeyer, D., & Pallo, M. (1995, January). An experiment in cross-curriculum education. Tech Directions, 32-33.

Lipton, E. (1994). Preparing the professionals of tomorrow requires an integrated foundation, XLIX (CITEA No. 2). California State University, Los Angeles, Department of Technology.

Rannels, L. (1991). The place of industrial arts in the academic community. Kappan, 72, 456-457.

Roberts, P. & Clark, D. (1994, March). Integrating Technology Education and Tech Prep. The Technology Teacher, 53, (6) 43-44.

Roegge, C & Ferej, A. (1995). But I've been doing this for years: informal integration of vocational and academic education pilot test report. [On-line report], Available: <http://ncrve.berkeley.edu/MDS-870>.

Salinger, G. (1994, February). Educational reform movements and technology education. The Technology Teacher, 53, (5) 6-8.

Stern, D. (1995). High school restructuring. [On-line report], Available: <http://ncrve.berkeley.edu/MDS-812>.

Suba, T., & Adcock, R. (1995, January). Tech Prep Evolves in Indiana. Tech Directions, 13-16.

Thielke, J. (1995, April). Building high school technology education. Tech Directions, 51-62.

United States Department of Education. (1994). Digest of education statistics.